

ingly adopted this value; and I have assigned it to 1827, though perhaps it belongs rather to 1828; the assignment of it to 1828 would render the value of {observed diff. Dec. — diff. Dec. by the Downing-Elkin orbit} greater than that entered in the table.

Dunlop's diff. of Declination may be assigned to 1826.0.

On examining the note-books and other MSS. on which Richardson's Paramatta Catalogue is based, which the Assistant Secretary was kind enough to place before me, I found they supported the view that there were no measures taken of *both*  $\alpha_1$  and  $\alpha_2$  *Centauri* before the end of 1825 or beginning of 1826; and I came to the conclusion that, for the present purpose, no notice need be taken of the Catalogue, the results therein contained being simply Dunlop's measures, which are given, slightly modified, in his papers in the Society's *Memoirs*.

Fallows' diff. of Dec. must be considerably too large. This is rendered evident by finding the sectorial areas for the intervals between his epoch and those of subsequent observers. It is, of course, impossible to say what amount of error attaches to his diff. Dec., but it seems likely that the error reaches some 4" or 5". The circumstance is not surprising, since his telescope did not separate the close components of *a Crucis*, which are about 5" distant from each other. At the same time it is to be remembered that Fallows was a remarkably careful observer; and it would be a mistake to attribute to him an error to which the inferiority of his instrument did not render him liable.

It appears from the table that concurrent testimony is borne by all the observers, from Henderson backwards, that the differences of Declination afforded by the Downing-Elkin orbit are too small. In fact, the largest diff. of Dec. which that orbit will admit of is about 18"; while, judging from recorded observations, the diff. may be supposed to reach some 20". From this it seems to follow that the periodic time must exceed seventy-six years; and then, having regard to Feuillée's important observation in 1709, discussed in my former Paper, it appears probable that the period of *a Centauri* extends over eighty-six, or more, years.

*Hampstead:*  
1886, March 3.

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*On the Orbit of 40 ( $\circ^2$ ) Eridani.* By J. E. GORE, M.R.I.A.

The star 40 ( $\circ^2$ ) *Eridani* with its distant double companion forms a remarkable ternary system. As far as I know, the elements of the orbit have not hitherto been published. The close pair B C have described over 200° of its apparent ellipse since it was measured by Sir W. Herschel in 1783. By means of the graphical method described in the *Handbook of Double Stars* by Messrs. Crossley, Gledhill and Wilson, I have computed the orbit, and find the following elements: —

## Elements of 40 Eridani (BC).

$P = 139.0$ years.	$\Omega = 146^\circ 20' (1880.0)$ .
$T = 1863.88$ .	$\lambda = 354^\circ 23'$ .
$e = 0.1362$ .	$a = 5''99$ .
$\gamma = 76^\circ 20'$ .	$\mu = -2^\circ 59$ .

From these elements we have the following formulæ:—

- (1)  $u - 7.80 \sin u = -2^\circ 59 (t = 1863.88)$ ,
- (2)  $\tan \frac{1}{2}V = 1.146 \tan \frac{1}{2}u$ ,
- (3)  $\tan (\theta_c - 146^\circ 20') = 0.23627 \tan (V + 354^\circ 23')$ ,
- (4)  $\rho = 5''99 (1 - 0.1362 \cos u) \frac{\cos (V + 354^\circ 23')}{\cos (\theta_c - 146^\circ 20')}$ ;

where  $u$  is the eccentric anomaly, and  $V$  the true anomaly for any epoch  $t$ ,  $\theta_c$  the position-angle, and  $\rho$  the distance.

The following table shows a comparison between the recorded observations and the positions computed by the above formulæ. The computed angles have been corrected for the effect of precession.

## 40 Eridani (BC).

## Comparison of Observations with Elements.

Epoch.	Observer.	$\theta_0$	$\theta_c$	$\theta_0 - \theta_c$	$\rho_0$	$\rho_c$	$\rho_0 - \rho_c$
1783.13	Sir W. Herschel	326.7	329.93	-2° 23'	4-8	6.41	"
1825.12	Struve	287	292.28	-5.28	—	—	—
1850.94	O. Struve	156.6	156.56	-0.04	3.96	4.29	-0.33
1851.06	Dawes	160.0	156.44	+3.56	3±	4.29	—
1851.49	O. Struve	155.0	155.96	-0.96	3.87	4.37	-0.50
1853.64	"	155.4	153.67	+1.73	3.93	4.66	-0.73
1854.79	"	155.3	152.55	+2.75	4.13	4.78	-0.65
1856.80	"	152.9	150.73	+2.17	4.51	4.97	-0.46
1857.82	"	153.0	149.84	+3.16	4.40	5.03	-0.63
1864.80	Winnecke	147.6	144.18	+3.42	4.45	5.12	-0.67
1864.84	O. Struve	147.6	144.18	+3.42	4.45	5.12	-0.67
1865.89	"	143.8	143.28	+0.52	4.26	5.03	-0.77
1869.10	"	140.4	140.24	+0.16	4.46	4.79	-0.33
1872.56	"	140.6	136.86	+3.74	4.62	4.35	+0.27
1873.99	"	133.9	135.13	-1.23	4.27	4.09	+0.18
1874.10	"	135.7	135.02	+0.68	4.99	4.11	+0.88
1875.14	"	138.1	133.6	+4.5	3.80	3.89	-0.09
1877.84	Cin. Obs.	127.5	129.34	-1.84	4.36	3.43	+0.93
1877.86	Burnham	128.2	129.34	-1.14	3.92	3.43	+0.49
1879.05	"	125.4	127.0	-1.60	3.66	3.22	+0.44
1880.09	"	121.3	124.5	-3.2	3.28	2.99	+0.29
1880.95	"	122.0	121.5	+0.5	3.16	2.74	+0.44
1881.84	"	119.0	119.7	-0.7	3.53	2.62	+0.91
1883.00	"	119.2	115.6	+3.6	3.07	2.39	+0.68

The elliptical motion is, of course, probably somewhat perturbed by the attraction of the principal star, which, though very distant, is much larger, its apparent magnitude being about  $4\frac{1}{2}$ , while the components of the binary pair are 9 and 10.8.

Assuming the above elements, and the parallax of the star at  $0''\cdot223$  (as found by Prof. Asaph Hall), I have computed the following figures, which may be of interest.

Taking the Sun's mean distance from the Earth as unity, I find

Distance of 40 Eridani from the Earth	...	...	...	924955
Mean distance between the components, B C	...	...	26.86	
Sum of masses of B C	...	...	...	1.003
Sun's mass = 1	...	...	...	

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*Some new Red and Orange-red Stars.* By the Rev. T. E. Espin.

The observations of the stars were made with a 9-inch Calver Reflector equatorially mounted, and with a  $17\frac{1}{4}$ -inch Calver reflector, equatorially mounted also, with driving clock, and circles reading in R.A. to 5 seconds, and in Declination to 1'. Since September 24 the observations were made with the latter instrument. The power used was a sweeping power of 70. The first column gives the number continued from the list given in vol. iii. *Liverpool Astronomical Society's Journal*, p. 82; the second, the D. M. number; the third the approximate R.A. and Declination brought up to 1885; the fourth, Argelander's magnitude; the fifth and sixth, the observed mean magnitude and colour; the seventh, the number of nights on which each star was observed; the eighth, the night it was detected. An asterisk denotes that the star was previously observed by my friend, the late Rev. T. W. Webb. Certain orange stars have been included, either because they are finely coloured, or because of a neighbouring blue star—a combination of frequent occurrence, the reason of which is at present unexplained. Mr. Webb's observations, and my own, where there seemed any reason for giving them in detail, will be found in the notes.

Abbreviations: RR, very red; R, red; R<sup>1</sup>, pale red; R<sup>2</sup>, very pale red. Shades of orange-red and orange denoted in the same way, by ORR, &c., and O.

No.	D.M.	R.A. 1885.	Decl.	Magnitude.		Colour.	Nights	Date.	Obs.	1885.
				Arg.	Obs.					
33	54° 11' 6	0 30° 6	+ 54° 35' 6	7.8	8.5	R <sup>2</sup>	1	Dec. 4		
34	39° 16' 7	38° 3	+ 40° 3° 0	7.1	7.0	OR <sup>2</sup>	3	Oct. 1		
35	57° 25' 8	1 12° 5	+ 57° 42' 3	8.8	8.5	R	3	Dec. 2		